

# 3.17 Graphs of Polar Equations

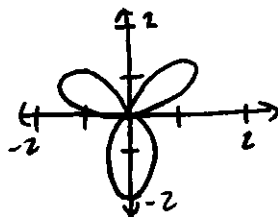
Key

Name \_\_\_\_\_ Date \_\_\_\_\_ Period \_\_\_\_\_

**SHORT ANSWER.** Write the word or phrase that best completes each statement or answers the question.

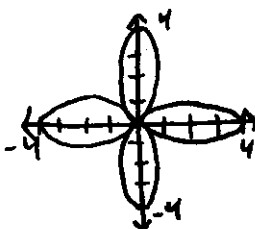
Draw a graph of the rose curve.

1)  $r = 2 \sin 3\theta, 0 \leq \theta \leq 2\pi$



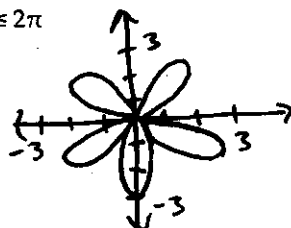
1) \_\_\_\_\_

2)  $r = 4 \cos 2\theta, 0 \leq \theta \leq 2\pi$



2) \_\_\_\_\_

3)  $r = -3 \sin 5\theta, 0 \leq \theta \leq 2\pi$

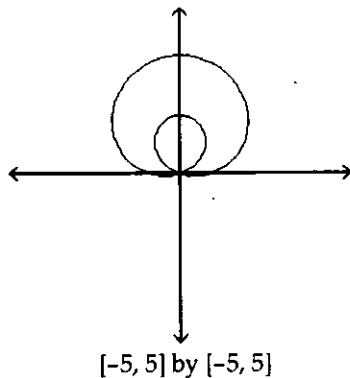


3) \_\_\_\_\_

**MATCHING.** Choose the item in column 2 that best matches each item in column 1.

The graph of a limaçon curve is given. Without using your graphing calculator, determine which equation is correct for the graph.

4)



A)  $r = 1 + 3 \sin \theta$

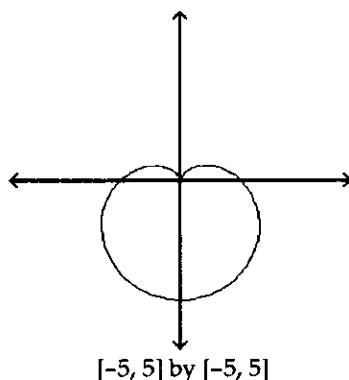
4) A

B)  $r = 1 + 3 \cos \theta$

C)  $r = 3 + \sin \theta$

D)  $r = 2 + 2 \sin \theta$

5)



A)  $r = 2 - 2 \sin \theta$

B)  $r = 2 + 2 \sin \theta$

C)  $r = 3 - 2 \sin \theta$

D)  $r = 1 - 3 \sin \theta$

E)  $r = 4 + \cos \theta$

F)  $r = 2 + 2 \cos \theta$

G)  $r = 2 + 3 \cos \theta$

H)  $r = 3 + 2 \cos \theta$

I)  $r = 3 + 2 \sin \theta$

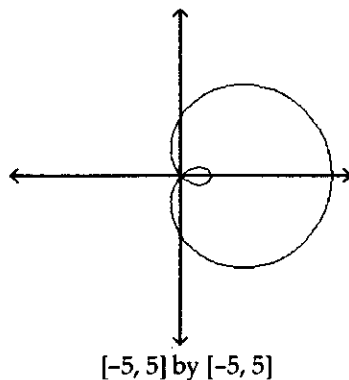
J)  $r = 3 + \sin \theta$

K)  $r = 1 + 3 \sin \theta$

5)

A

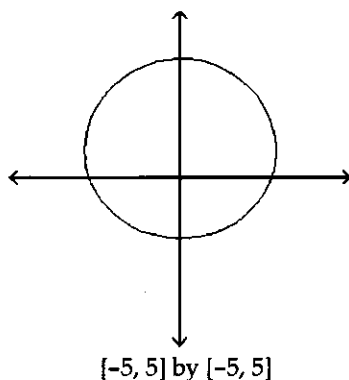
6)



6)

G

7)



7)

J

**SHORT ANSWER.** Write the word or phrase that best completes each statement or answers the question.

**Solve the problem.**

- 8) For what values of  $\theta$  ( $0 \leq \theta < 2\pi$ ) do maximum  $r$ -values occur on the graph of the polar equation  $r = 2 \sin 4\theta$ ? Note that a maximum  $r$ -value occurs at a point that is the maximum distance from the pole.

8)

$r = 2 \sin 4\theta \rightarrow$  rose curve  
 $a = 2$ ,  $n = 4$

max.  $r$  value: 2

petals =  $2n = 8$

graph:  $y = |2 \sin 4x|$

Find  $x$ -values when  $y$  is max  $0 \leq x \leq 2\pi$

$\theta = x = \frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}, \frac{9\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8},$

$\frac{15\pi}{8}$

- 9) For what values of  $\theta$  ( $0 \leq \theta < 2\pi$ ) do maximum  $r$ -values occur on the graph of the polar equation  $r = 2 \cos 4\theta$ ? Note that a maximum  $r$ -value occurs at a point that is the maximum distance from the pole.

9) \_\_\_\_\_

$r = 2 \cos 4\theta$ , -rose curve  
 $a = 2$ ,  $n = 4$  petals:  $2n = 8$  max  $r = 2$

Graph:  $\theta = x = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \pi, \frac{5\pi}{4}, \frac{3\pi}{2}, \frac{7\pi}{4}$

- 10) For what values of  $\theta$  ( $0 \leq \theta < 2\pi$ ) do maximum  $r$ -values occur on the graph of the polar equation  $r = 2 + 4 \sin \theta$ ? Note that a maximum  $r$ -value occurs at a point that is the maximum distance from the pole.

10) \_\_\_\_\_

$r = 2 + 4 \sin \theta$  -Limacon curve  
 $a = 2$ ,  $b = 4$  max  $r: 2 + 4 = 6$

$6 = 2 + 4 \sin \theta$   
 $1 = \sin \theta$   $\theta = \pi/2$

- 11) For what values of  $\theta$  ( $0 \leq \theta < 2\pi$ ) do maximum  $r$ -values occur on the graph of the polar equation  $r = -2 + 5 \cos \theta$ ? Note that a maximum  $r$ -value occurs at a point that is the maximum distance from the pole.

11) \_\_\_\_\_

$r = -2 + 5 \cos \theta$  Limacon curve  
 $a = -2$ ,  $b = 5$  max  $r = -2 + 5 = 3$

$3 = -2 + 5 \cos \theta$   
 $1 = \cos \theta$ ,  $\theta = 0$

Analyze the graph of the given polar curve. Include the following information: If possible, describe the shape of the graph (circle, rose curve, limacon, etc.), and state the domain, range, and maximum  $r$ -value of the graph.

- 12)  $r = 3$  Circle, radius 3

12) \_\_\_\_\_

Domain: All reals

Range:  $\{3\}$

max  $r$ : 3

- 13)  $\theta = \pi/3$

straight line passing through origin,  
 making an angle of  $\pi/3$  with the  $x$ -axis.

13) \_\_\_\_\_

Domain:  $\theta = \pi/3$  no max. value  
 Range: All reals

- 14)  $r = 2 \sin 3\theta$

14) \_\_\_\_\_

Rose petal w/ 3 petals

Domain: All reals

Range:  $[-2, 2]$

max  $r$  value: 2

- 15)  $r = 5 + 4 \sin \theta$

15) \_\_\_\_\_

Limacon curve

Domain: All reals

Range:  $[1, 9]$

max  $r$  value: 9

16)  $r = 4 + 4 \cos \theta$

16) \_\_\_\_\_

Limacon curve  
 Domain: All reals  
 Range:  $[0, 8]$   
 max r value: 8

17)  $r = 5 + 2 \cos \theta$

17) \_\_\_\_\_

Limacon curve  
 Domain: All reals  
 Range:  $[3, 7]$   
 max r-value: 7

18)  $r = 2 + 5 \cos \theta$

18) \_\_\_\_\_

Limacon curve:  
 Domain: All reals  
 Range:  $[-3, 7]$   
 max r-value: 7

19)  $r = 1 - \cos \theta$

19) \_\_\_\_\_

Limacon curve  
 Domain: All reals  
 Range:  $[0, 2]$   
 max r-value: 2

20)  $r = 2\theta$

20) \_\_\_\_\_

Spiral of Archimedes  
 Domain: All reals  
 Range:  $[0, \infty)$   
 no max r-value

21)  $r^2 = \sin 2\theta, 0 \leq \theta \leq 2\pi$

21) \_\_\_\_\_

$r = \sqrt{\sin 2\theta}$

Lemniscate curve

Domain:  $[0, \frac{\pi}{2}] \cup [\pi, \frac{3\pi}{2}]$

Range:  $[0, 1]$

max r-value: 1